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Lake Metigoshe (South Basin) Bottineau County North Dakota

National Eutrophication Survey, Corvallis, Oreg

Prepared for

Corvallis Environmental Research Lab, Oreg

Oct 76

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

LAKE METIGOSHE (SOUTH BASIN)

BOTTINEAU COUNTY

NORTH DAKOTA

EPA REGION VIII

WORKING PAPER No. 573

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

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REPORT

ON

LAKE METIGOSHE (SOUTH BASIN)

BOTTINEAU COUNTY

NORTH DAKOTA

EPA REGION VIII

WORKING PAPER No. 573

WITH THE COOPERATION OF THE

NORTH DAKOTA STATE DEPARTMENT OF HEALTH

AND THE

NORTH DAKOTA NATIONAL GUARD

OCTOBER, 1976

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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F O R E W O R D

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the North Dakota State Department of Health for professional involvement, to the North Dakota National Guard for conducting the tributary sampling phase of the Survey, and to those North Dakota wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

Norman L. Peterson, Director, and the staff of the Division of Water Supply and Pollution Control of the Department of Health, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

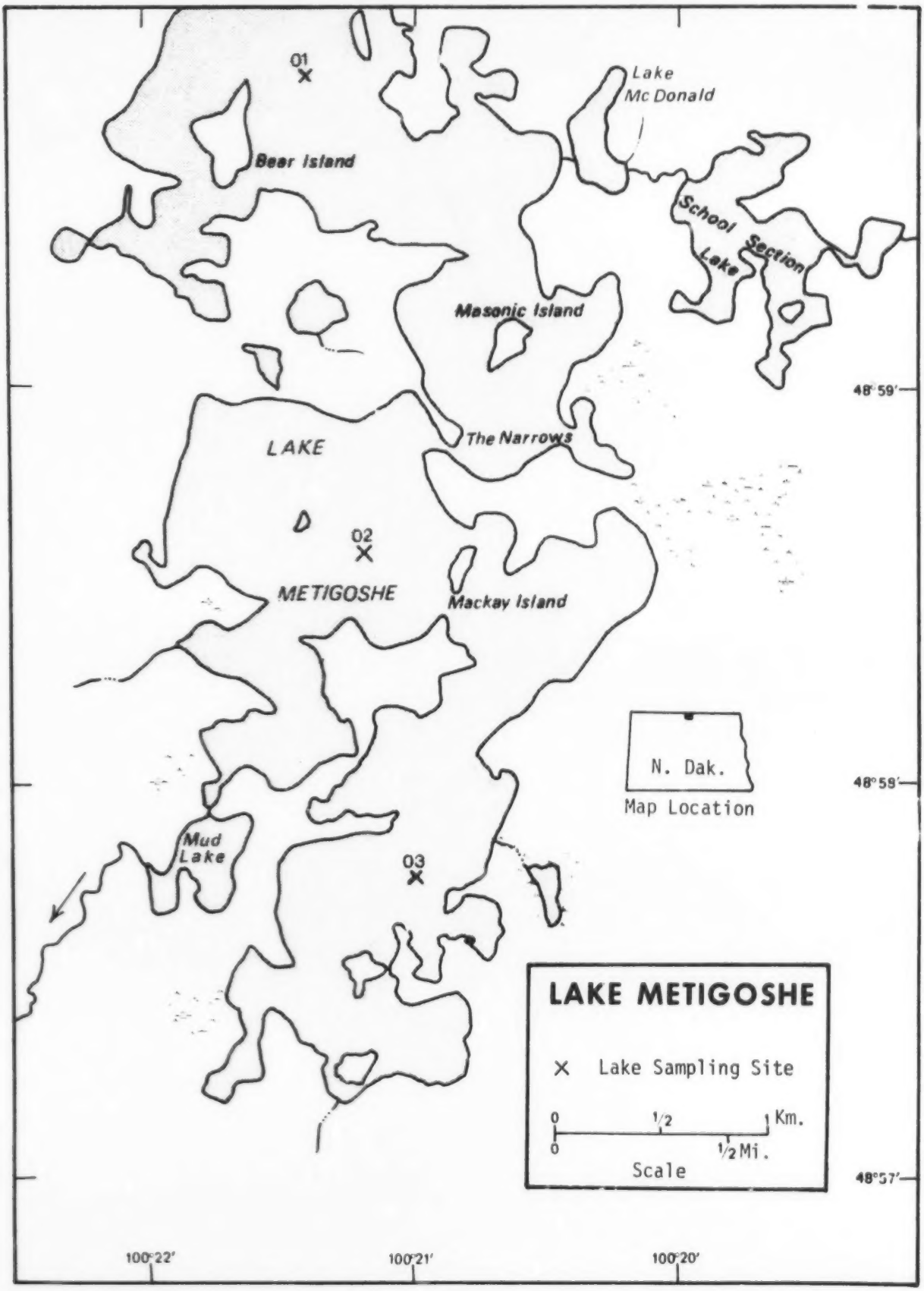
Major General LaClair A. Melhouse, the Adjutant General of North Dakota, and Project Officer Colonel Irvin M. Sande, who directed the volunteer efforts of the North Dakota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES AND RESERVOIRS

STATE OF NORTH DAKOTA

NAME	COUNTY
Ashtabula	Barnes, Griggs
Audubon	McLean
Brush	McLean
Darling	Renville, Ward
Devils	Benson, Ramsey
Jamestown	Stutsman
LaMoure	LaMoure
Matejcek	Walsh
Metigoshe	Bottineau
Pelican	Bottineau
Sakakawea	Dunn, McKenzie, McLean, Mercer, Mountrail, Williams
Spiritwood	Stutsman
Sweet Briar	Morton
Whitman	Nelson, Walsh


01
Lake
Mc Donald
Bear Island
School Section
Lake
Masonic Island
48°59'
The Narrows
LAKE
02
METIGOSHE
Mackay Island
N. Dak.
Map Location
48°58'
Mud
Lake
03
LAKE METIGOSHE
Lake Sampling Site
0
1/2
Km.
0
1/2 Mi.
Scale
48°57'
100°22'
100°21'
100°20'

LAKE METIGOSHE (SOUTH BASIN)

STORET NO. 3809

I. INTRODUCTION

Lake Metigoshe (South Basin) was included in the National Eutrophication Survey as a water body of interest to the North Dakota Department of Health. Tributaries and nutrient sources were not sampled, and this report relates only to the lake sampling data.

Lake Metigoshe, a natural lake, has a high recreational and fishing usage. Although the major source of water to the lake is from Canada, localized drainage from surrounding agricultural and wooded lands reach the lake (Peterson, 1974).

II. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Lake Metigoshe (South Basin) is mesotrophic. This lake ranked first in overall trophic quality when the 14 North Dakota lakes sampled in 1974 were compared using a combination of six parameters*. One lake had less median total phosphorus, two had less and one had the same median dissolved phosphorus, one had less median inorganic nitrogen, two had less mean chlorophyll a, and only one had a greater mean Secchi disc transparency.

Survey limnologists observed submerged macrophytes in July.

B. Rate-Limiting Nutrient:

The algal assay samples were lost in transit. The lake data indicate nitrogen limitation at both sampling times.

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* See Appendix A.

III. LAKE CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 3.74 kilometers^2.
2. Mean depth: 2.8 meters.
3. Maximum depth: 6.7 meters.
4. Volume: 10.472×10^6 m^3.

B. Precipitation*.

1. Year of sampling: 59.0 centimeters.
2. Mean annual: 42.8 centimeters.

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† Table of metric equivalents--Appendix B.
†† Henegar, 1975.
* See Working Paper No. 175, "...Survey Methods, 1973-1976".

IV. LAKE WATER QUALITY SUMMARY

Lake Metigoshe (South Basin) was sampled twice during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Both times, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (see map, page v). During both visits, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 5.5 meters at station 1, 5.2 meters at station 2, and 3.4 meters at station 3.

The sampling results are presented in full in Appendix C and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE METIGOSHE
STORET CODE 3809

PARAMETER	1ST SAMPLING (7/17/74) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (9/13/74) 3 SITES RANGE	MEAN	MEDIAN	0 SITES RANGE	MEAN	MEDIAN
TEMP (C)	24.2 - 25.5	24.7	24.6	11.3 - 12.2	11.8	11.8	******	**********	
DISS OXY (MG/L)	6.0 - 11.2	8.4	8.0	7.0 - 10.4	8.1	8.0	******	**********	
CNDCTVY (MCROMO)	500. - 532.	522.	529.	303. - 329.	322.	328.	******	**********	
PH (STAND UNITS)	8.7 - 9.1	8.9	8.8	8.3 - 8.8	8.5	8.5	******	**********	
TOT ALK (MG/L)	252. - 274.	262.	261.	236. - 314.	281.	289.	******	**********	
TOT P (MG/L)	0.019 - 0.047	0.032	0.033	0.021 - 0.295	0.077	0.031	******	**********	
ORTHO P (MG/L)	0.008 - 0.026	0.016	0.016	0.003 - 0.013	0.008	0.009	******	**********	
NO2+NO3 (MG/L)	0.040 - 0.070	0.046	0.040	0.020 - 0.040	0.022	0.020	******	**********	
AMMONIA (MG/L)	0.030 - 0.060	0.042	0.040	0.040 - 0.100	0.057	0.060	******	**********	
KJEL N (MG/L)	1.200 - 1.400	1.278	1.300	1.000 - 3.900	1.450	1.100	******	**********	
INORG N (MG/L)	0.070 - 0.130	0.088	0.080	0.060 - 0.120	0.080	0.080	******	**********	
TOTAL N (MG/L)	1.240 - 1.440	1.323	1.340	1.020 - 3.920	1.472	1.120	******	**********	
CHLRPYL A (UG/L)	8.3 - 12.4	10.8	11.8	6.7 - 13.9	9.9	9.1	******	**********	
SECCHI (METERS)	2.7 - 3.3	3.0	3.0	1.9 - 4.0	2.6	1.9	******	**********	

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
07/17/74	1. *Fragilaria sp.*	797
	2. *Cryptomonas sp.*	258
	3. *Chroomonas sp.*	129
	4. *Scenedesmus sp.*	108
	5. *Dinobryon sp.*	36
	Other genera	497
	Total	1,874
09/13/74	1. *Microcystis sp.*	489
	2. *Cryptomonas sp.*	245
	3. *Tetraedron sp.*	245
	4. *Dinobryon sp.*	153
	5. *Melosira sp.*	92
	Other genera	856
	Total	2,080

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (μg/l)
07/17/74	1	11.8
	2	8.3
	3	12.4
09/13/74	1	13.9
	2	6.7
	3	9.1

C. Limiting Nutrient Study:

The algal assay sample was lost in shipment.

The lake data indicate nitrogen limitation at both sampling times; i.e., mean inorganic nitrogen/orthophosphorus ratios were 6/1 and 10/1 in July and August, respectively.

V. LITERATURE REVIEWED

Henegar, Dale, 1975. Personal communication (lake morphometry). ND Game & Fish Dept., Bismarck.

Peterson, Norman L., 1974. Personal communication (general lake information). ND Dept. of Health, Bismarck.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
3801	LAKE ASHTABULA	27 (3)	54 (7)	15 (2)	8 (1)	62 (8)	38 (5)	204
3802	LAKE AUDUBON	69 (9)	46 (6)	46 (6)	69 (9)	46 (6)	69 (9)	345
3803	BRUSH LAKE	77 (10)	77 (10)	38 (5)	38 (5)	81 (10)	81 (10)	392
3804	LAKE DARLING	15 (2)	38 (5)	23 (3)	0 (0)	38 (5)	23 (3)	137
3805	DEVILS LAKE	0 (0)	69 (9)	31 (4)	23 (3)	15 (2)	0 (0)	138
3806	JAMESTOWN RESERVOIR	54 (7)	15 (2)	62 (8)	62 (8)	96 (12)	54 (7)	343
3807	LAKE LA MOURE	8 (1)	8 (1)	69 (9)	54 (7)	4 (0)	8 (1)	151
3808	MATEJCEK LAKE	38 (5)	0 (0)	8 (1)	100 (13)	23 (3)	31 (4)	200
3809	LAKE METIGOSHE	92 (12)	92 (12)	92 (12)	85 (11)	81 (10)	81 (10)	523
3811	PELICAN LAKE	85 (11)	100 (13)	100 (13)	77 (10)	31 (4)	100 (13)	493
3812	LAKE SAKAKAWEA (GARRISON	100 (13)	62 (8)	85 (11)	92 (12)	54 (7)	92 (12)	485
3813	SPIRIT WOOD LAKE	46 (6)	23 (3)	77 (10)	31 (4)	4 (0)	46 (6)	227
3814	SWEET BRIAR RESERVOIR	62 (8)	85 (11)	54 (7)	15 (2)	96 (12)	62 (8)	374
3815	WHITMAN LAKE	27 (3)	31 (4)	0 (0)	46 (6)	69 (9)	15 (2)	188

.AKE DATA TO BE USED IN RANKINGS

8<

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3801	LAKE ASHTABULA	0.260	0.160	472.250	40.892	10.600	0.170
3802	LAKE AUDUBON	0.067	0.220	446.222	11.322	11.000	0.015
3803	BRUSH LAKE	0.066	0.095	449.143	29.114	9.300	0.010
3804	LAKE DARLING	0.274	0.250	466.750	60.075	11.600	0.180
3805	DEVILS LAKE	0.630	0.140	449.333	38.508	14.600	0.469
3806	JAMESTOWN RESERVOIR	0.144	0.365	438.667	19.400	8.800	0.078
3807	LAKE LA MOURE	0.438	0.380	421.400	19.720	15.000	0.290
3808	MATEJCEK LAKE	0.228	0.440	475.167	2.683	14.400	0.179
3809	LAKE METIGOSHE	0.032	0.080	389.167	10.367	9.000	0.010
3811	PELICAN LAKE	0.034	0.070	364.500	10.950	12.800	0.006
3812	LAKE SAKAKAWEA (GARRISON	0.016	0.150	406.733	6.883	10.800	0.007
3813	SPIRIT WOOD LAKE	0.156	0.290	417.833	34.667	15.000	0.082
3814	SWEET BRIAR RESERVOIR	0.092	0.090	440.800	39.000	8.800	0.031
3815	WHITMAN LAKE	0.260	0.260	478.333	27.067	9.200	0.185

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3809	LAKE MELISSOME	523
2	3811	PELICAN LAKE	443
3	3812	LAKE SAKAKAWEA (GARRISON	485
4	3803	BRUSH LAKE	392
5	3814	SWEET BRIAR RESERVOIR	374
6	3802	LAKE AUDUBON	345
7	3806	JAMESTOWN RESERVOIR	343
8	3813	SPIRIT WOOD LAKE	227
9	3801	LAKE ASHTABULA	204
10	3808	MATEJCEK LAKE	200
11	3815	WHITMAN LAKE	188
12	3807	LAKE LA MOURE	151
13	3805	DEVILS LAKE	138
14	3804	LAKE DARLING	137

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/02/06

3-0901
48 59 47.0 100 21 25.0
LAKE METIGOSHE
38009 NORTH DAKOTA

13<

11EPALES 2111202
3 0020 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00510 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/07/17	14 00	0000	24.9	7.6	119	530	8.40	256	0.050	1.400	0.040	0.025
	14 00	0005	24.5	7.4		529	8.80	256	0.040	1.300	0.040	0.020
	14 00	0016	24.2	6.0		526	8.70	268	0.050	1.200	0.040	0.026
74/09/13	11 00	0000	12.2	7.4	76	329	8.27	236	0.040	1.200	0.040	0.006
	11 00	0009	12.0	7.6		329	8.31	290	0.040	1.100	0.020K	0.009
	11 00	0018	11.9	7.0		329	8.25	288	0.040	1.100	0.020K	0.010

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCUT LT REMNING PERCENT
74/07/17	14 00	0000	0.036	11.8	
	14 00	0005	0.034		
	14 00	0015			1.0
	14 00	0016	0.047		
74/09/13	11 00	0000	0.029	13.9	
	11 00	0002			50.0
	11 00	0009	0.029		
	11 00	0012			5.0
	11 00	0018	0.032		
	11 00	0020			1.0

K VALUE KNOWN TO BE
LESS THAN INDICATED

ET RETRIEVAL DATE 76/02/06

380903
48 57 47.0 100 21 02.0
LAKE METIGOSHE
38009 NORTH DAKOTA

15<

11EPALES 2111202
3 0013 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/07/17	14 50	0000	25.5	9.8	108	510	9.10	270	0.030	1.300	0.040	0.009
	14 50	0005	25.1	10.0		507	9.10	261	0.030	1.200	0.040	0.008
	14 50	0010	24.4	11.2		500	9.10	252	0.030	1.300	0.040	0.010
74/09/13	12 10	0000	11.4	8.4	156	303	8.81	278	0.060	1.000	0.020K	0.004
	12 10	0011	11.3	10.4		303	8.81	258	0.100	3.900	0.020K	0.013

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/07/17	14 50	0000	0.024	12.4	
	14 50	0005	0.019		
	14 50	0010	0.041		
	14 50	0013			2.0
74/09/13	12 10	0000	0.021	9.1	
	12 10	0003			50.0
	12 10	0011	0.295		
	12 10	0013			9.0

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/02/06

3-0902
48 58 35.0 100 21 13.0
LAKE METIGOSHE
38009 NORTH DAKOTA

14<

11EPALES 2111202
3 0016 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/07/17	14 25	0000	24.9	8.0	130	532	8.80	274	0.060	1.300	0.070	0.017
	14 25	0005	24.6	7.8		531	8.80	264	0.050	1.200	0.060	0.015
	14 25	0013	24.4	8.0		529	8.80	254	0.040	1.300	0.040	0.016
74/09/13	11 40	0000	11.8	8.2	76	327	8.47	294	0.060	1.200	0.020	0.003
	11 40	0008	11.8	8.0		329	8.47	292	0.060	1.100	0.020	0.009
	11 40	0017	11.7	8.0		327	8.47	314	0.060	1.000	0.020	0.011

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/07/17	14 25	0000	0.030	8.3	
	14 25	0005	0.033		
	14 25	0013	0.022		
	14 25	0016			2.0
74/09/13	11 40	0000	0.141	6.7	
	11 40	0003			50.0
	11 40	0008	0.031		
	11 40	0014			5.0
	11 40	0017	0.041		
	11 40	0019			1.0